Clinical results and patient-reported outcomes in breast reconstructive surgery

Negenborn, V.L.

2018

CHAPTER 3

A retrospective study on surgical outcomes and patient satisfaction of EGIS® ADM in one-stage implant-based breast reconstruction

Negenborn VL, Van Turnhout AAWM, Fuchs SP, Lisabeth-Broné K, Vermulst N, Vogten JM, Twisk JWR, Vriens-Nieuwenhuis EJC, Mullender MG, Van der Sluis WB

Submitted

ABSTRACT

Introduction The use of an acellular dermal matrix (ADM) in implant-based breast reconstruction (IBBR) is supposed to improve cosmetic outcomes and facilitates a direct-to-implant procedure. Although promising, the use of ADMs is reported to be associated with higher complication rates. This study aims to assess the surgical outcomes and patient satisfaction of immediate one-stage IBBR with EGIS® ADM.

Methods All patients who underwent immediate one-stage IBBR with an EGIS ADM at our institution were retrospectively identified. A retrospective chart review was performed, recording baseline demographics, surgical characteristics, perioperative complications and reoperations. Risk factors for complications including seroma and implant removal were assessed by uni- and multivariable logistic GEE analyses. Patients with a minimum of 6 months follow-up were invited to digitally fill out the BREAST-Q, a validated questionnaire to assess patient satisfaction after breast reconstruction.

Results In total, 84 patients (51 unilateral, 33 bilateral reconstructions) were included with a mean age of 48 ± 11.3, a median BMI of 24 (18.3; 32.6) kg/m^2 and median follow-up of 14 (range 0-26) months. Implant removal due to complications occurred in 7 (6.0%) reconstructions, because of wound dehiscence, infection and/or necrosis. Postoperative seroma drainage was performed in 29.9% (n = 35) reconstructions. The response rate of the BREAST-Q was 81% (n = 56/69 invited patients). After a mean follow-up of 18 months, satisfaction with breast (59.0 ± 14.5) and outcome (71.2 ± 19.6) were good.

Conclusion The use of EGIS ADM in one-stage implant-based breast reconstruction was associated with a low explantation rate and good postoperative patient satisfaction.

INTRODUCTION

Breast reconstruction with an implant is the most performed reconstruction method.[1] It is performed either as a one-stage (i.e. direct-to-implant) or two-stage (expander/implant) procedure. In both methods, an acellular dermal matrix (ADM) can be used additionally. ADMs are tissue matrices, either derived from human or animal tissue. They undergo several processing steps, including mechanical separation of tissues, decellularization, disinfection and dehydration or lyophilisation.[2] Animal-derived ADMs are made from porcine- or bovine-derived collagen.[3]

The use of ADMs in breast reconstructive surgery is thought to have several advantages. The ADM provides support of the implant and improves implant coverage, which facilitates a direct-to-implant based reconstruction and results in a more natural ptotic breast. Furthermore, it may result in a cosmetically favourable lateral border, less nipple replacement and less muscle animations.[2, 3] In the long-term, ADMs may result in reduced capsular contracture rates, even in irradiated breasts.[4] Because of improved cosmetic outcome, the use of ADMs in breast reconstructive surgery is supposed to result in higher patient satisfaction. However, data on patient satisfaction after ADM-assisted breast reconstruction is scarce.[3] Reported complication rates after implant-based breast reconstruction (IBBR) with an ADM vary widely, from less than 5% up to 50%. Complications comprise minor or severe complications including infection, wound dehiscence, necrosis and subsequent implant removal.[5-7] Providing additional data on ADM use and associated complications is useful in further understanding procedural safety as well as patient satisfaction.[8, 9]

EGIS® is a porcine-derived ADM that is used in abdominal surgery, e.g. for abdominal wall reconstruction, extensive hernia repair and in breast reconstructive surgery.[10] To our knowledge, no articles are currently available reporting on the use of EGIS ADM in IBBR. The aim of this study was to investigate the predictive value of patient and surgery related factors on surgical outcomes including seroma and implant loss after one-stage IBBR with EGIS. Additionally, patient satisfaction after this reconstruction method was assessed.

METHODS

Patients

All patients who underwent immediate one-stage IBBR with an EGIS ADM at Tergooi Hospital, Hilversum, The Netherlands, were retrospectively identified from the hospital registry. A retrospective chart review was performed recording:

- Baseline demographics (age at reconstruction (in years), body mass index (BMI, kg/m^2), history of smoking, medical history, previous breast surgery and indication for mastectomy (preventive or therapeutically).
- Surgical characteristics (uni- or bilateral reconstruction, type of incision (periareolar/ transverse, vertical scar) and nipple-sparing or not, mastectomy resection weight (in gram) and size of inserted prosthesis (cc), and hospital admission in days).
- Peri- and postoperative complications (bleeding, seroma, infection, wound dehiscence, necrosis).
- (Neo)adjuvant therapies (chemo-, radio-, hormone and targeted therapy).
- Reoperations due to complications and secondary revisions.

Seroma was defined as clinical suspicion of seroma followed by needle aspiration(s). Incisions were grouped into nipple sparing or not-nipple sparing and periareolar and transverse or a vertical scar and Wise pattern. Regular outpatient follow-up visits were planned two and six weeks after surgery and then annually or as needed (when a prophylactic mastectomy was performed).

Surgical technique

At our institution, an oncological surgeon and plastic surgeon collaborate during this procedure. The oncological surgeon performs the skin sparing mastectomy, with assistance of the plastic surgeon. After the mastectomy, the plastic surgeon performs the reconstructive procedure. During surgery, all rules for hygienic prosthetic surgery were followed to decrease the risk of infection (eg, one touch with change of gloves before handling the implant and a closed-door policy). The patient is marked preoperatively while standing. Intravenous Flucloxacilline is used as prophylactic antibiotic regime. Under general anesthesia, the patient is placed in supine position with both arms abduced. The surgical area is disinfected with chlorhexidine and both breasts are exposed. An incision is made according to the pre-operative planning, which could be periareolar, vertical or Wise

and nipple sparing or skin sparing. After the skin-sparing mastectomy is performed, the resection specimen is weighed. The retropectoral pocket is created, after releasing the costal origin of the muscle. The inframammary fold is defined using absorbable sutures (Vicryl 2/0). The EGIS ADM (21 × 12 cm, thickness 0.8 mm) is flushed with saline solution for 3 times during 2-3 minutes. The prosthesis is placed and the ADM is sutured to the caudal border of the pectoralis muscle using Vicryl 3/0 absorbable sutures. Two surgical drains (Redon) are placed, one in the pocket of the prosthesis, the second in the plane between ADM and skin flap. The skin is sutured with Vicryl 3/0 for the dermis and Monocryl 5/0 intracutaneous. Flucloxacillin 4dd1 gram is administered for five days (starting before incision, 24h IV followed by 4 days orally). Drains are removed when production of fluid is less than 20 mL/24 hours with a limit of 14 days. No bra or supportive garment is needed. Patients are advised to limit physical exercise and using force in the ipsilateral arm during six weeks to prevent disrupture of the pectoral major muscle from the ADM.

Patient-reported outcome measurement

Patients were invited to fill out the BREAST-Q reconstruction module, a validated, standardized questionnaire for evaluating results after mastectomy and reconstruction.[11] All patients with a definitive implant and at least 6 months follow-up were invited to participate. Patients with less than 6 months follow-up and patients with implant loss and no new reconstruction yet were not invited.

The BREAST-Q reconstruction module contains 14 domains regarding satisfaction with breasts (Q1), visible (Q2a) and feeling of rippling (Q2b), satisfaction with outcome (Q3), psychosocial well-being (Q4), sexual well-being (Q5), physical well-being: chest and upper body (Q6), satisfaction with nipples (Q10), satisfaction with care regarding information (Q11), surgeon (Q12), the medical team (Q13) and office staff (Q14). The domains Physical Well-being with Abdomen and Trunk (Q7) and Satisfaction with Abdomen (Q8,9) were deemed not applicable in this study.

The QScore Scoring Software (developed by Pusic et al, at the Memorial Sloan-Kettering Cancer Center, New York) was used to convert the BREAST-Q scores ranging from 1 through 4 or 5 to a total score ranging from 0 to 100. Only scores of domains Q2a and Q2b are not converted, these scores range from 1 (very dissatisfied) to 4 (very satisfied). Higher Q-Scores indicate higher patient satisfaction.[12] Both the BREAST-Q and the QScore Scoring Software are free available for non-profit academic research and clinical care.

Statistical analyses

Descriptive analyses were conducted for the baseline characteristics. Normally distributed variables were presented as means with standard deviations. Not normally distributed variables as medians with ranges. Incidences were represented as the number of cases and percentages. To assess the predictive value of patient and surgery related factors for seroma and implant loss, uni- and multivariable logistic generalised estimating equations (GEE analyses) were performed. Because data were analysed per breast, GEE was used to adjust for the dependency of the observations within one patient. Factors with a univariable p-value below 0.20 were selected for multivariable GEE analyses. A backward selection procedure was used to obtain the final models

BREAST-Q scores were reported as mean scores. Differences in patient and surgery related factors between responders and non-responders on the BREAST-Q were assessed with student's t-test, Chi square test and Mann-Whitney U. For the analyses, IBM SPSS statistics version 22 was used.

Ethical statement

The study was performed in accordance with the Declaration of Helsinki, guidelines for Good Clinical Practice and STROBE guidelines.[13] The study protocol was approved by the local medical ethical committee (Commissie Toetsingsprotocollen Tergooi Ziekenhuizen, reference number 17.020). Written informed consent was obtained digitally from all participating patients. This study was (partially) funded by Tergooi Wetenschapsfonds, a local research grant provider without connections to the product manufacturer. None of the authors has a (financial) tie to the ADM product.

RESULTS

Patients

A flow chart of study participation is presented in Figure 1. A total of 87 patients underwent breast reconstruction augmented with EGIS ADM. Three patients were excluded because they underwent two-stage IBBR. For the analyses of the complications, 84 patients (51 unilateral, 33 bilateral reconstructions) were included. An overview of patient characteristics is presented in Table 1.

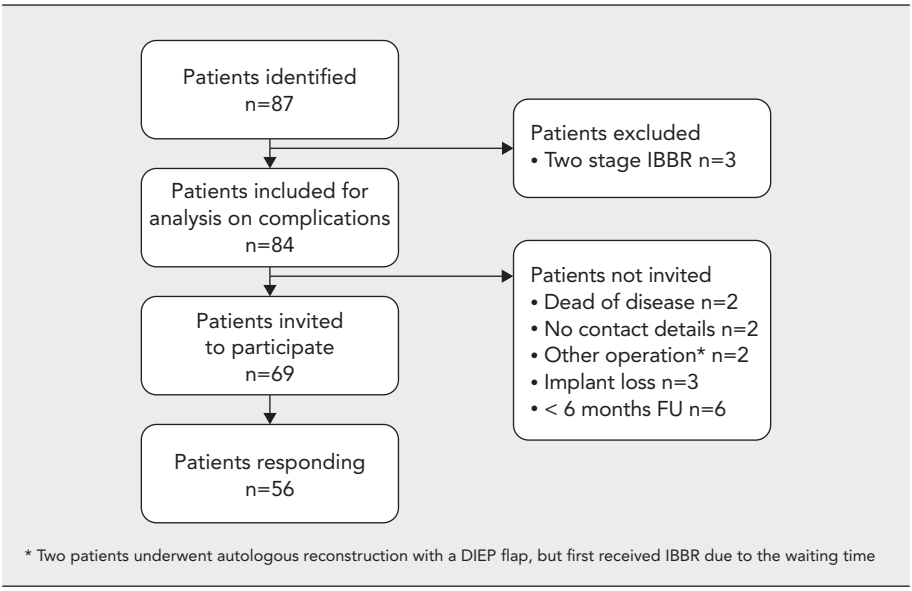

Figure 1 Flow chart of study participation

Complications

An overview of postoperative complications is presented in Table 2. Implant failure was observed seen in 6.0% of the reconstructions (n = 7 breasts, n = 6 patients). In one patient, who underwent bilateral reconstruction, bilateral implant failure was observed. All patients with implant loss underwent mastectomy for oncological reasons and had a periareolar/transverse incision. The majority of patients (n = 5 patients, n = 6 reconstructions) with implant loss received a bilateral procedure. None of the patients with implant failure had chemo- or targeted therapy (Table 1).

As reconstruction after implant failure, an expander/implant was chosen in two patients and a latissimus dorsi flap was in one. Three patients (4 reconstructions) had no new reconstruction yet.

Other complications, that did not require implant removal, were (wound) infection (8.5%, n = 10 reconstructions) and minor skin necrosis (6.8%, n = 8). Surgery was performed for infection (rinsing of the implant, 3.4%, n = 4) and removal of necrosis (6.8%, n = 8) (Table 2). In 35 breasts (29.9%), one or more needle aspirations of seroma was performed (median 1.0, range 1; 5). In the multivariable model, a larger difference between mastectomy weight and inserted prosthesis (OR1.54 (1.12; 2.11), p = 0.007) and use of hormone therapy (OR2.62 (1.05; 6.55), p = 0.039) were associated with an increased risk on seroma (Table 4).

Mean + SD	Included patients (n = 84; n = 117 reconstructions)
Age (in years)	48.0 ± 11.3
BMI* (kg/m^2)	23.9 (18.3; 32.6)
Chronic disease	33.3% (n = 28)
Previous breast surgery	**6.0% (n = 7)**
Augmentation	3.4% (n = 4)
Reduction	0.9% (n = 1)
BCS	0.9% (n = 1)
Mastectomy	0.9% (n = 1)
Current or previous smoker	22.6% (n = 19)
Side of reconstruction	
Unilateral	60.7% (n = 51)
Bilateral	39.3% (n = 33)
Reason	
Preventive	35.0% (n = 41)
Oncologic	63.2% (n = 74)
Mastopathy	1.7% (n = 2)
Incision	
Nipple sparing	**64.1% (n = 75)**
Periareolar	60.7% (n = 71)
Vertical scar, Wise	2.6% (n = 3)
Skin sparing	**35.9% (n = 42)**
Periareolar / transverse	29.9% (n = 35)
Vertical scar	6.0% (n = 7)
Mastectomy weight* (gram)	
Median – range	381.0 – 110; 1008
Size inserted prosthesis* (gram)	
Median – range	335.0 – 175; 580
Chemotherapy (per patient)	
Neoadjuvant	39.3% (n = 33)
Adjuvant	17.9% (n = 15)
Hormone therapy	46.4% (n = 39)
Targeted therapy	7.1% (n = 6)
Radiotherapy (per breast)	26.5% (n = 31)
Hospital admission* (days)	
Median – range	3.0 – 2; 7
Clinical follow-up* (months)	
Median – range	14.0 – 0; 26
Follow-up BREAST-Q (months)	
Mean ± SD	18 ± 6.4

Table 1 Baseline characteristics of all included patients (n = 84 patients; 117 reconstructions). * Non normal distribution

Mean + SD	Reconstructions (n = 117)
Seroma	29.9% (n = 35)
Number of punctures*	
Mean +SD	1.7 ± 0.9
Median – range	1.0 – 1; 5
Infection	
Antibiotics only	5.1% (n = 6)
Surgery (rinsing of implant)	3.4% (n = 4)
Surgery for necrosis	6.8% (n = 8)
Implant removal	**6.0% (n = 7)**
Infection	1.7% (n = 2)
Necrosis	2.6% (n = 3)
Combination	1.7% (n = 2)
Reconstruction	
No reconstruction yet	3.3% (n = 4)
Expander/implant	1.7% (n = 2)
LD	0.9% (n = 1)

* Non normal distribution

Table 2 Complications + reoperations of all included patients (n = 84 patients; 117 reconstructions)

	Univariable analyses OR (95% CI)	p-value
Implant removal		
Age (years)	1.04 (0.97; 1.11)	0.32
Body mass index (kg/m^2)	1.10 (0.92; 1.32)	0.30
Smoking	4.97 (0.91; 27.14)	0.06
Indication	N.A.*	(omitted)
Mastectomy weight** (gram)	1.0 (0.68; 1.43)	0.98
Difference mastectomy weight – inserted prosthesis	0.97 (0.45; 2.10)	0.93
Incision	N.A.***	(omitted)
Nipple sparing mastectomy	2.63 (0.43; 16.06)	0.30
Neoadjuvant chemotherapy	1.86 (0.38; 9.23)	0.45
Adjuvant chemotherapy	N.A.****	(omitted)
Hormone therapy	2.0 (0.33; 12.22)	0.45
Targeted therapy	N.A.****	(omitted)
Radiotherapy	2.33 (0.31; 17.76)	0.42
Seroma	2.22 (0.27; 18.11)	0.46

* All patients with an implant loss underwent a mastectomy for therapeutical reasons. ** OR calculated for a 100g weight difference. *** All patients with an implant loss had an periareolar/transverse incision. **** No patients with an implant loss had chemo or targeted therapy.

Table 3 Analyses on the occurrence of implant removal

	Univariable analyses OR (95% CI)	p-value	Multivariable analyses OR (95% CI)	p-value
Seroma formation				
Age (years)	1.05 (1.01; 1.09)	0.01		
Body mass index (kg/m^2)	1.07 (0.95; 1.20)	0.25		
Smoking	0.85 (0.29; 2.5)	0.76		
Indication	2.09 (1.0; 4.36)	0.05		
Mastectomy weight* (gram)	1.24 (1.0; 1.52)	0.05		
Difference mastectomy weight – inserted prosthesis	1.58 (1.17; 2.16)	<0.01	1.54 (1.12; 2.11)	0.01
Incision	1.94 (0.56; 6.71)	0.30		
Nipple-sparing mastectomy	3.52 (1.42; 8.70)	0.01		
Neoadjuvant chemotherapy	1.16 (0.51; 2.66)	0.72		
Adjuvant chemotherapy	1.43 (0.45; 4.52)	0.54		
Hormone therapy	3.0 (1.22; 7.34)	0.02	2.62 (1.05; 6.55)	0.04
Targeted therapy	N.A.**	(omitted)		
Radiotherapy	1.52 (0.65; 3.56)	0.34		

* OR calculated for a 100g weight difference. ** No patients with seroma had targeted therapy.

Table 4 Analyses on the formation of seroma

Patient-reported outcomes measured with the BREAST-Q

In total, 69 patients were invited via email to fill-out the BREAST-Q (Figure 1). The response rate was 81.2% (n = 56 patients). There were no significant differences in any of the baseline characteristics between responding and non-responding patients. The mean follow-up between the surgery and completing the BREAST-Q was 18 ± 6.4 months. The mean satisfaction with breasts BQ1 was 59.0 ± 14.5 and the satisfaction with outcome was 71.2 ± 19.6. Scores on sexual well-being were 57.3 ± 24.9 and satisfaction with nipples 59.7 ± 30.6 Patients were very satisfied with their surgeon (96.5 ± 8.5), medical (84.1 ± 21.4) and office staff (89.6 ± 18.4) (Table 5).

BREAST-Q (mean ± SD)	Responders (n = 56)
Satisfaction with Breast (Q1; n=56)	59.0 ± 14.5
Satisfied with implant rippling / wrinkling (Q2; n = 56)	
Visible	2.8 ± 1.1
Feeling	2.7 ± 1.2
Satisfaction with outcome (Q3; n = 54)	71.2 ± 19.6
Psychosocial well-being (Q4; n = 54)	72.0 ± 18.7
Sexual well-being (Q5; n = 53)	57.3 ± 24.9
Physical well-being: Chest (Q6; n = 54)	67.3 ± 14.4
Satisfaction with nipples (Q10; n = 7)	59.7 ± 30.6
Satisfaction with information (Q11; n = 54)	75.5 ± 15.5
Surgeon (Q12; n = 54)	96.5 ± 8.5
Medical staff (Q13; n = 54)	84.1 ± 21.4
Office staff (Q14; n = 54)	89.6 ± 18.4

Table 5 Patient satisfaction, measured with the BREAST-Q

DISCUSSION

In this study, the surgical outcomes and patient-reported satisfaction was assessed after ADM-assisted one-stage implant-based breast reconstruction (IBBR). The implant failure rate after IBBR with EGIS (6.0%, n = 7 reconstructions) was at the lower end of the reported implant failure rates in literature, ranging from less than 5% to 26%.[3, 5-7, 14] A high questionnaire

response rate was achieved, > 80%, and patient-reported satisfaction with breasts (59.0 ± 14.5) was comparable to previous reported outcomes after IBBR, ranging between 58 and 68.[14-16]

This is the first study in which the use of EGIS ADM in IBBR is reported. In only one article, the use of EGIS was described for nipple areolar reconstruction to serve as a base plate to give support and offer bulk and projection. No complications were noted.[17] There are several ADMs for IBBR on the market. In the Netherlands, human ADMs are not available. Lee and Mun performed a literature review regarding studies comparing different types of ADMs. The majority of the articles concern studies regarding human derived ADMs; only two included studies evaluated the use of a porcine derived ADM (Strattice).[18] The use of ADMs in breast reconstruction is associated with a wide range of complications, ranging from less than 5% to 50%.[5-7] As usually only one type of ADM is used in mainly single center studies, no comparison regarding different types of ADMs can be made. In this study, the implant failure rate of 6.0% (n = 7 reconstructions, n = 6 patients) was low. The EGIS ADM is a thin ADM (thickness 0.8 mm) when compared to other ADMs, including Strattice pliable and Alloderm with a variable thickness of 1-2 mm.[19] This may result in fast ADM ingrowth and neo-angiogenesis by early permeability of the matrix by blood vessels. Future studies comparing different types of ADMs are necessary to determine the possible influence of the type of ADM on complication rates.

Implant removal was caused by infection or wound healing problems, including wound dehiscence and necrosis. These causes for implant failure are comparable to previous studies reporting on the use of ADMs in IBBR.[5, 7, 20] All patients with an implant loss were operated for oncological reasons. Common risk factors for complications after IBBR include a high BMI, high weight of resection specimen, radiotherapy and the type of incision.[21, 22] In this study, the transverse incision was associated with implant explantation.[22, 23] The majority of patients with implant loss received a bilateral reconstruction (5 out of 6 patients). The literature is inconsistent regarding the influence of bilateral surgery on complications. Both an increased risk as well as comparable complication rates are reported after a bilateral surgery compared to unilateral surgery.[24, 25, 26]
The thickness of the mastectomy flap should be optimal, meaning that all breast tissue is ablated but leaving viable skin flaps for the reconstruction.[27] In our experience, narrow collaboration between the surgeon per-

forming the mastectomy and the reconstructive surgeon is essential to ensure viable mastectomy skin flaps. In this study, the oncological surgeon and reconstructive surgeon collaborated during the procedure to prevent unnecessary damage to the skin flap. This may also have contributed to a low rate of skin necrosis.

The patient satisfaction with breasts was 59.0 ± 14.5, measured with the BREAST-Q. Only two previous studies also measured patient satisfaction with the BREAST-Q in ADM-assisted one-stage IBBR reconstruction, but they did not use the QScore Scoring Software to convert the crude scores. Comparison to their results is therefore not possible.[28, 29] There is a high demand for studies reporting on PROMs after ADM-assisted one-stage IBBR. Previous studies have investigated the patient satisfaction after IBBR and their results are comparable to the satisfaction rate in this study (satisfaction with breasts ranging from 56.2 (51.7) to 68.3; satisfaction with outcome 57.1 to 70.1 and surgeon 78.4 to 87.2).[9, 14, 15, 30] In this study, no preoperative BREAST-scores were available. Mundy et al recently investigated normative values for the BREAST-Q modules and the patient-reported outcomes of this study are comparable to their BREAST-Q scores. Only the physical well-being with chest was remarkably lower, with a postoperative score of 67.3 ± 14.4 versus 93 ± 11 in the baseline cohort of Mundy et al.[31] Larger prospective studies regarding direct-to-implant breast reconstruction comparing different types of ADMs are needed to differentiate between the types of ADMs and the influence on patient-reported outcomes.

This is the first study reporting on the use of EGIS in IBBR. Complications were extensively investigated to identify risk factors, which support surgeons in their decision to determine which patients are eligible for ADM-assisted one-stage IBBR. All eligible patients were invited to fill out the BREAST-Q and the response rate to the questionnaire was high (> 80%). The study is limited by its retrospective design, and no preoperative BREAST-Q scores were available. Only one type of ADM (EGIS) was used, which hampers legitimate comparison to other ADMs. Also no control group of only direct-to-implant breast reconstruction without an ADM was included.

The use of EGIS ADM in implant-based breast reconstruction was associated with a low explantation rate and good patient satisfaction. Future studies are necessary to investigate the additional value of ADMs in general and which ADM should be used in particular.

REFERENCES

1. American Society of Plastic Surgeons. Plastic Surgery Statistics Report 2016. Available at http://www.plasticsurgery.org/ *(Accessed at August 18th, 2017)*.
2. Macadam SA, Lennox PA. Acellular dermal matrices: Use in reconstructive and aesthetic breast surgery. *Can J Plast Surg*. 2012;20(2):75-89.
3. Potter S, Browning D, Savović J, et al. Systematic review and critical appraisal of the impact of acellular dermal matrix use on the outcomes of implant-based breast reconstruction. *Br J Surg*. 2015;102(9):1010-25.
4. Salzberg CA, Ashikari AY, Berry C, et al. Acellular Dermal Matrix-Assisted Direct-to-Implant Breast Reconstruction and Capsular Contracture: A 13-Year Experience. *Plast Reconstr Surg*. 2016;138(2):329-37.
5. Dikmans REG, Negenborn VL, Bouman MB, et al. Two-Stage Implant-Based Breast Reconstruction vs Immediate One-Stage Implant-Based Breast Reconstruction augmented with an Acellular Dermal Matrix: An open-label, phase IV Multicentre Randomised Controlled Trial. *Lancet Oncol*. 2016;Dec 21.
6. Kalus R, Dixon Swartz J, Metzger SC. Optimizing Safety, Predictability, and Aesthetics in Direct to Implant Immediate Breast Reconstruction: Evolution of Surgical Technique. *Ann Plast Surg*. 2016;76 Suppl 4:S320-7.
7. Salzberg CA, Dunavant C, Nocera N. Immediate breast reconstruction using porcine acellular dermal matrix (Strattice): long-term outcomes and complications. *J Plast Reconstr Aesthet Surg*. 2013;66(3):323-8.
8. Colakoglu S, Khansa I, Curtis MS, et al. Impact of complications on patient satisfaction in breast reconstruction. *Plast Reconstr Surg*. 2011;127(4):1428-36.
9. Liu C, Zhuang Y, Momeni A, et al. Quality of life and patient satisfaction after microsurgical abdominal flap versus staged expander/implant breast reconstruction: a critical study of unilateral immediate breast reconstruction using patient-reported outcomes instrument BREAST-Q. *Breast Cancer Res Treat*. 2014;146(1):117-26.
10. EGIS® Acellular Dermal Matrix, QuaMedical, http://quamedical.nl/ *(Accessed at Sept 14th, 2017)*.
11. Pusic AL, Klassen AF, Scott AM, et al. Development of a new patient-reported outcome measure for breast surgery: the BREAST-Q. *Plast Reconstr Surg*. 2009;124(2):345-53.
12. DiLaura A, Stefan C, Pusic AL. QScore Scoring Software. Available at https://webcore.mskcc.org/breastq/scoring.html *(Accessed at March 14th, 2017)*.
13. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet*. 2007;370(9596):1453-7.
14. Srinivasa DR, Garvey PB, Qi J, et al. Direct-to-Implant versus Two-Stage Tissue Expander/Implant Reconstruction: 2-Year Risks and Patient-Reported Outcomes from a Prospective, Multicenter Study. *Plast Reconstr Surg*. 2017;140(5):869-77.
15. Sorkin M, Qi J, Kim HM, et al. Acellular Dermal Matrix in Immediate Expander/Implant Breast Reconstruction: A Multicenter Assessment of Risks and Benefits. *Plast Reconstr Surg*. 2017.
16. Thorarinsson A, Frojd V, Kolby L, et al. Long-Term Health-Related Quality of Life after Breast Reconstruction: Comparing 4 Different Methods of Reconstruction. *Plast Reconstr Surg Glob Open*. 2017;5(6):e1316.
17. Vidya R, Salem F, Iqbal FM, et al. Acellular dermal matrix based nipple reconstruction: A modified technique. *JPRAS Open*. 2017;13:62-67.

18. Lee KT, Mun GH. A Meta-analysis of Studies Comparing Outcomes of Diverse Acellular Dermal Matrices for Implant-Based Breast Reconstruction. *Ann Plast Surg*. 2017.
19. AlloDerm® Regenerative Tissue Matrix Ready To Use Portfolio Ordering Information. Lifecell, An Acelity Company, January 1, 2015. Accessed at http://www.lifecell.com/file-admin/media/files/downloads/Product_Catalogs/MLC3942-R1_US_AlloDerm_RTU_Portfolio_2015_ORDERING_FINAL.pdf on November 22, 2017.
20. Lardi AM, Ho-Asjoe M, Mohanna P-N, et al. Immediate breast reconstruction with acellular dermal matrix: Factors affecting outcome. *J Plast Reconstr Aesthet Surg* 2014;67(8):1098-105.
21. El-Sabawi B, Sosin M, Carey JN, et al. Breast reconstruction and adjuvant therapy: A systematic review of surgical outcomes. *J Surg Oncol*. 2015;112(5):458-64.
22. Munhoz AM, Aldrighi CM, Montag E, et al. Clinical outcomes following nipple-areola-sparing mastectomy with immediate implant-based breast reconstruction: a 12-year experience with an analysis of patient and breast-related factors for complications. *Breast Cancer Res Treat*. 2013;140(3):545-55.
23. Garwood ER, Moore D, Ewing C, et al. Total skin-sparing mastectomy: complications and local recurrence rates in 2 cohorts of patients. *Ann Surg*. 2009;249(1):26-32.
24. Miller ME, Czechura T, Martz B, et al. Operative risks associated with contralateral prophylactic mastectomy: a single institution experience. *Ann Surg Oncol*. 2013;20(13):4113-20.
25. Osman F, Saleh F, Jackson TD, et al. Increased postoperative complications in bilateral mastectomy patients compared to unilateral mastectomy: an analysis of the NSQIP database. *Ann Surg Oncol*. 2013;20(10):3212-7.
26. Silva AK, Lapin B, Yao KA, et al. The Effect of Contralateral Prophylactic Mastectomy on Perioperative Complications in Women Undergoing Immediate Breast Reconstruction: A NSQIP Analysis. *Ann Surg Oncol*. 2015;22(11):3474-80.
27. Robertson SA, Rusby JE, Cutress RI. Determinants of optimal mastectomy skin flap thickness. *Br J Surg*. 2014;101(8):899-911.
28. El Hage Chehade H, Headon H, Wazir U, et al. Nipple-sparing mastectomy using a hemi-periareolar incision with or without minimal medial-lateral extensions; clinical outcome and patient satisfaction: A single centre prospective observational study. *Am J Surg*. 2017;213(6):1116-24.
29. Headon H, Kasem A, Manson A, et al. Clinical outcome and patient satisfaction with the use of bovine-derived acellular dermal matrix (SurgiMend) in implant based immediate reconstruction following skin sparing mastectomy: A prospective observational study in a single centre. *Surg Oncol*. 2016;25(2):104-10.
30. Vu MM, De Oliveira GS, Jr., Mayer KE, et al. A Prospective Study Assessing Complication Rates and Patient-Reported Outcomes in Breast Reconstructions Using a Novel, Deep Dermal Human Acellular Dermal Matrix. *Plast Reconstr Surg Glob Open*. 2015;3(12):e585.
31. Mundy LR, Homa K, Klassen AF, et al. Breast Cancer and Reconstruction: Normative Data for Interpreting the BREAST-Q. *Plast Reconstr Surg*. 2017;139(5):1046e-55e.